

tion are frequent. The coaches and trainers of elite athletes involved in these sports generally have high levels of expertise and can configure and incorporate this version of the knee sleeve into their existing training programs. Similarly, clinicians such as physiotherapists can use this version of the device to provide patients with feedback during rehabilitation exercises.

[0076] Another version of the knee sleeve can include telemetry so that knee angle data can be recorded on computer in real time for later analysis. Of course in this version, the audio tone would be a secondary indicator and therefore optional. This refined version is a field instrument to measure knee angle during movement activities and possibly during games and training as well. A microwave transmitter sends the data to the remotely positioned receiver where it is stored in real time. This version is a particularly useful biomechanical measurement tool suitable for any of the above mentioned sports as well as for field testing of sports such as alpine skiing.

[0077] For participants in sports who do not have access to trainers with expertise in designing training programs, the knee sleeve may be marketed with some type of interactive multi-media. For instance, the sleeve may be sold with a CD to guide the players through appropriate activities to use the sleeve and improve their techniques. Of course clinicians can also provide patients with take home instructions in some form of multi-media to help speed up their rehabilitation.

[0078] In a still further modification, additional polymer strips can be provided to enable monitoring of the rotation of the leg relative to the thigh (in addition to monitoring knee flexion). Once again, the sleeve can emit feedback via an audio tone, vibration or storage of the data. The ability to monitor tibial rotation in addition to knee flexion would be more appropriate in sports and activities in which the non-contact ACL rupture mechanism involves tibial rotation as well as deceleration. Such movements are typical during side stepping manoeuvres in soccer and the rugby codes.

[0079] The knee sleeve versions of the present invention discussed above are purely illustrative. Skilled workers in this field will readily recognise many other applications and embodiments that use a wearable sensor. These include embodiments such as:

- [0080] use of the knee sleeve in training footballers to kick "through" the ball;
- [0081] to monitor head, torso and or limb motion to teach correct posture during activities of daily living, work and recreation;
- [0082] to monitor elbow motion during bowling training in cricket to detect an illegal bowling action involving excessive elbow flexion and providing the bowler with feedback in order to correct their technique;
- [0083] to monitor torso motion using a wearable vest with arrays of fabric strain gauges incorporated to be used in training cricketers to bowl;
- [0084] to monitor wrist motion during basketball or netball shooting practise in order to detect if the hand is deviating medially or laterally;

[0085] monitoring elbow and/or wrist motion during a tennis serve;

[0086] monitoring the torso, wrist, elbow and/or knee movements during golf swings;

[0087] configuring the invention so that the trigger point can be incrementally increased or decreased to reflect the progressive increasing of performance (degrees of movements) of a patient during a rehabilitation program;

[0088] configuring the device into a form such as a glove in order to allow a person to generate the input signals for a computer or other equipment; and

[0089] the invention may be incorporated into toys or other playthings in order to provide a response to certain interactions with the child.

[0090] FIGS. 4 to 8 show various embodiments and refinements of the more fundamental design. FIG. 4a shows the current path provided by the element coating formed into a U-shaped configuration. The sides 9 and 10 of the U shape are aligned with the direction of extension in the underlying fabric caused by the movement of interest. In this configuration, the ends of the current path 11 and 12 are closer together which simplifies the connection of the electronics 3 and allows for a more compact design.

[0091] In FIG. 4, the conductive polymer coating is formed into a multi-pronged configuration 13. Each of the prongs 14 to 19 are aligned with the direction of extension in the underlying fabric caused by the movement to be monitored. Each prong can be designed to have a different conductivity so that the electronics 3 can be attached to any selected pair of prongs in order to change the response characteristics of the sensor.

[0092] The feedback device shown in FIG. 5 incorporates multiple sensors. Two separate U-shaped strips 20 and 21 are connected to respective wheatstone bridge circuits 22 and 23. In turn, the wheatstone bridges 22 and 23 are linked to a combined comparator and signal generator 24. By designing the strips so that they trigger a feedback indication at different thresholds of strain, the multi-strip sensor can provide simple and direct bio-feedback on the rate of movement in a biological structure. For example, the strip 20 may trigger a feedback indication at a threshold of 20% strain whereas the strip 21 triggers at a threshold of 40% strain. By monitoring the time between triggers, the rate of movement can be derived. Accordingly, the use of a network of differentially triggered sensors positioned on a range of body parts coupled with suitable telemetry can provide a complex analysis of its motion.

[0093] The use of a laminated structure enables a device to get a better linear range, response time as well as quicker textile recall. FIG. 6a diagrammatically shows three polymer coatings of a laminate, each with different operative ranges. P_1 has an operative range of 20%. Hence, any extension greater than this threshold will trigger the feedback indication associated with P_1 . Likewise P_2 and P_3 have operative ranges of 40% and 60% respectively whereby their feedback indications trigger at these respective thresholds. FIG. 6b presents this in a graphical format to highlight the extended operational range provided by the laminated structure.